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RAIL CAPABILITY TO MOVE PEOPLE AND MATERIAL DURING NATIONAL EMERGENCIES

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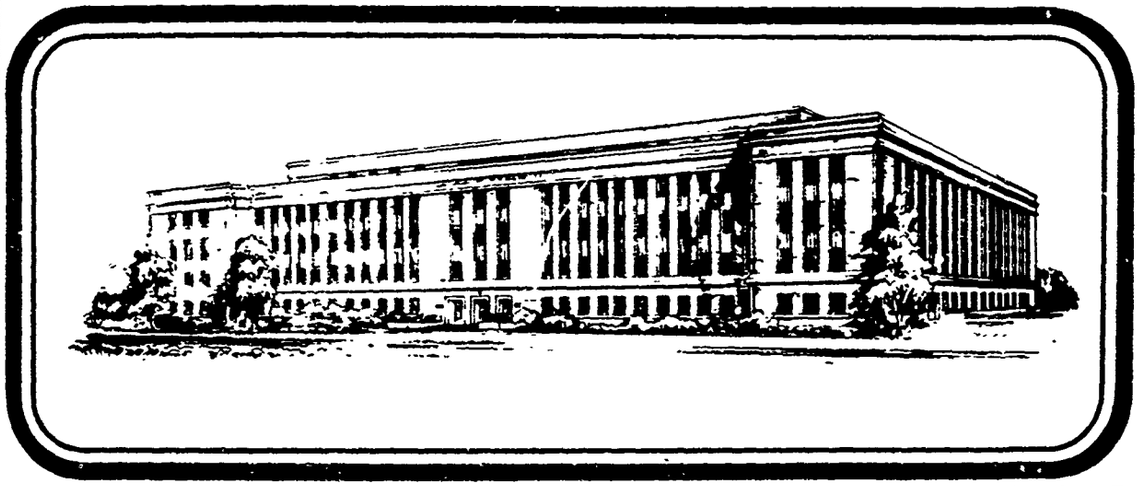

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This paper assesses the capability of the United States railroads to move people and materials during national emergency. A reference point is World War II, when the railroads moved 74 percent of commercial intercity passenger traffic and 69 percent of intercity freight during 1944, the peak war year. From that reference point, trends in elements of the railroad industry are examined to indicate significant changes in railroad's capabilities.

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INDUSTRIAL COLLEGE OF THE ARMED FORCES
WASHINGTON, D.C.

MOBILIZATION STUDY

RAIL CAPABILITY TO MOVE PEOPLE AND MATERIAL DURING NATIONAL EMERGENCIES

by

Commander David M. Graves, USN
Commander Jon P. Monson, USN

A RESEARCH REPORT SUBMITTED TO THE FACULTY
IN—
FULFILLMENT OF THE RESEARCH
REQUIREMENT

RESEARCH SUPERVISOR: CAPTAIN TISE EYLER, USN

INDUSTRIAL COLLEGE OF THE ARMED FORCES

April 1983

DISCLAIMER-ABSTAINER

This research report represents the views of the authors and does not necessarily reflect the official opinion of the Industrial College of the Armed Forces, the National Defense University, or the Department of Defense.

ABSTRACT OF STUDENT RESEARCH REPORT
INDUSTRIAL COLLEGE OF THE ARMED FORCES

NAME OF RESEARCHER (S)	TITLE OF REPORT
David M. Graves, Commander, USN Jon P. Monson, Commander, USN	Rail Capability to Move People and Material During National Emergencies
SECURITY CLASSIFICATION OF REPORT	**REPORT NUMBER**
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ABSTRACT

Problem Statement: This paper assesses the capability of the United States railroads to move people and materials during national emergency. A reference point is World War II, when the railroads moved 74 percent of commercial intercity passenger traffic and 69 percent of intercity freight during 1944, the peak war year. From that reference point, trends in elements of the railroad industry are examined to indicate significant changes in railroad's capabilities.

Findings/Conclusions:

1. The Mainline Strategic Rail Network is sufficient to meet mobilization needs. A study is needed to assure adequate rail connections exist between the mainlines and defense suppliers and installations.

2. Airlines will be the prime people mover in any future war.

3. Railroads have shifted their capability to move material from non-containerized cargo in box cars to cargo pre-loaded into containers.

4. The Staggers Rail and Motor Carrier Acts of 1980 will lead to more container use. Therefore, in the event of conflict, the United States will need the domestic capacity to fabricate containers.

Recommendations

1. DOD assess the state of rail service between defense suppliers and installations and the Mainline Strategic Rail Network.

2. DOD refine defense transport needs to capabilities of nation's railroads.

3. DOD move more into containerized transport.

4. DOD assess the surge capability to fabricate containers and stockpile containers if needed.

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EXECUTIVE SUMMARY

The purpose of this mobilization research study is to assess the capability of the United States railroads to move people and materials during national emergency. A reference point for the study is World War II, when the railroads were responsible for moving 74 percent of the commercial intercity passenger traffic and 69 percent of the intercity freight during 1944, the peak year of the war. From that reference point, trends in elements of the railroad industry are examined, to indicate significant changes in the railroads' capabilities. From that, several conclusions are developed as well as recommendations for both further study and specific action.

CHAPTER I: INTRODUCTION

In a brief introduction, the basis for the study is discussed. Given the assumption that the railroads will play similar roles in future national emergencies as they have in the past, it is proposed that the capabilities of the railroads to meet that role should be assessed.

CHAPTER II: U.S. RAILROADS IN WORLD WAR II

This chapter examines the role of the U.S. railroads in World War II. Despite limited quantities of rolling stock and operating resources curtailed by competing war demands, the railroads managed to move impressive quantities of materials and numbers of people during the years of the war. The reasons for this are described.

CHAPTER III: TRENDS IN RAILROAD CAPABILITIES

Several elements of the railroad industry are examined in this chapter. More specifically, trends in the following areas are addressed: the railroads' share of the intercity passenger traffic; the numbers of passenger train cars owned and operated; the railroads' share of the intercity freight business; the numbers of freight cars owned and operated; the composition of the freight car fleet; the modes of freight shipment; the capacities of freight cars; the numbers of locomotives in service; the average freight train loads and revenue ton-miles; the miles of track owned; the condition of railways essential to the nation's defense; and the economic condition of the railroads in general.

CHAPTER IV: CONCLUSIONS AND RECOMMENDATIONS

Given the trends since World War II, this chapter draws conclusions relative to the overall condition of railways critical to the national defense, to the ability of the railroads to carry people, to the capability of the railroads to support a national emergency by moving non-containerized cargo, and to the future of the economic condition of the railroads. From these conclusions, the following recommendations are set forth:

- that DOD conduct a study to assess the state of rail service between defense suppliers and the strategic rail network, and of rail facilities within defense installations.

- that DOD work closely with the rail industry to refine the defense transportation needs to the capabilities of the nation's railroads.

- that DOD move more into containerized transportation by prestaging Warfare Reserve material in containers for rapid movement.

- that DOD assess the surge capability of fabricating containers and stockpiling them if needed.

CHAPTER I

INTRODUCTION

The United States railroad system has, with little doubt, played a significant role in helping the United States of America become the impressive economic power it is today. In the 1800s, the railroads supported the move to expand into the Western frontier. By the beginning of the 20th century, the railroads were the dominant mode of domestic transportation.

Regretfully, for many, the role of the railroads has declined over the past sixty years. Part of the decline has been the result of the invention of the airplane and the subsequent airline industry takeover of the passenger-carrying business. Part of the decline has been the development of modern highway systems, and the emergence of the trucking industry as an important carrier of raw materials and finished products. Part of the decline has been the result of the heavy regulation of the railway industry, essentially preventing it from being a competitive hauler.

Nevertheless, the railroads of today continue to have a very important role in support of the United States' industrial society. For one reason, the railroads share with only the trucking industry the ability to move goods and materials across inland surface east-west routes. Secondly, materials movements by rail are frequently better than by truck for several reasons: "(1) the capability to move large quantities of cargo, staged and easily retained in the planned sequence required for efficient ship stowage at the port of embarkation, (2) appreciably fewer size and weight limitations on the movement of oversize/overweight cargo . . . , (3) railroads free up personnel

that would otherwise be engaged in highway convoy operation, (4) safety and security in transit, and (5) port congestion can be controlled by regulating the rate at which trains are released from en route rail yards."[1]

Today, in the peacetime environment, the railroads play an important, but not dominant, role in supporting the U.S. defense establishment. In Fiscal Year 1981, the railroads accounted for 11 percent of the total tonnage and 16 percent of the total ton-miles contracted by defense.[2] "Thus, while railroads are important transporters of Defense Department traffic, their primary importance to the nation's security is as carriers of materials necessary for the production of goods used by the military."[3]

But of greater importance, and concern, is the role of the railroads in support of the nation and the defense establishment in the event of mobilization. In past World Wars, the railroads carried significant quantities of people and materials. There is no reason to doubt that the railroads should also play a significant role in support of any future large scale mobilization.

In the event of such a mobilization, there will be a requirement to move three categories of people within the continental United States. The first category is CONUS shore-based active duty personnel to sites of embarkation, either on ships or transoceanic flights. The second involves movement of reserve personnel to their mobilization units. The third group includes new inductees from home of record to training commands and thence on to points of embarkation.

With respect to the movement of materials, there are two stages of shipment. Initially, equipments and supplies will have to be moved from storage sites to embarkation points. Subsequently, there will be a need to

move raw materials to major industries which have converted to war materials production. Later, the finished products will have to be moved from the factories to the embarkation sites.

It is anticipated that the U.S. railroads will play a major role in meeting CONUS transportation requirements and that sufficient sealift/airlift capacity exists to move materials from embarkation sites to theaters of operations. This study assesses the capacity of the rail system to handle the necessary people and materials movement at time of national emergency.

FOOTNOTES

CHAPTER I (Pages 1-3)

[1]Military Traffic Management Command, STRACNET Condition Report, A Study of Rail Lines Important to National Defense for the Armed Services Committees or the Congress (Washington, D.C.: June 1981), p. 6.

[2]Military Traffic Management Command, Worldwide Traffic Management Summary, Fiscal Year 1981 (Washington, D.C.: 1981), p. 24.

[3]White, Eston T., National Security Management - Transportation (National Defense University, Washington, D.C.: 1981), p. 35.

CHAPTER II

U.S. RAILROADS IN WORLD WAR II

The second World War broke out in Europe on 1 September 1939. Less then a year later, in 1940, the United States inaugurated a comprehensive National Defense Program. Early in 1941, a policy of lend-lease of materials and supplies to the countries then fighting the Axis was adopted. Late in 1941, the United States entered the war as an active participant.

Prior to 1941, the record year for ton-miles of revenue freight carried by the railroads was 1929, and the record year for passenger-miles was 1920. In 1942, after a year at war, revenue ton-miles exceeded the 1929 record by 42.6 percent, and passenger-miles exceeded the 1920 record by 14.6 percent. This was accomplished with 15.2 percent less locomotive capacity than 1929 and 7.3 percent less than 1920; the total capacity (tons) of freight cars was 16.5 less than 1929; and the number of passenger cars was 30.8 percent less than 1920.[1] The performance of the railroads in 1943 and 1944 was more remarkable because increased heavy traffic was successfully handled with little increase in equipment.

The railroads, with short supply of rolling stock and expansion drastically curbed by competing war demands, were able to carry a quantity of traffic which rose high above former peaks because, in the dozen years following World War I, the railroads spent several billion dollars in the improvement of roadbed, track, and terminal facilities. While their rolling stock decreased in quantity, it increased in efficiency. Average speed of movement was increased, in part, because a large volume of short-haul package

freight was moved by truck. Much the same happened in passenger service with the automobile. In the loading and unloading of freight, the railroads had, in striking contrast with the situation at the beginning of World War I, splendid cooperation between the railroads and shippers in the movement of an unparalleled volume of freight.

Heavy loads and the reduction of empty or partially loaded mileage also were means of getting more work out of equipment. Heavier loading requirements issued by the Office of Defense Transportation resulted in increased efficiency of operation, including faster handling by both railroads and shipping. This was equivalent to adding over 600,000[2] freight cars to the supply.

Equipment was made to do more work by keeping it in repair. This principle was applied intensively to railroad rolling stock. The percentages of bad-order locomotives and cars were brought to all-time low levels.

Passenger as well as freight equipment, shifted from routes or areas of surplus, aided in meeting deficits elsewhere. Nearly 900[3] locomotives were leased by railroads which had more than they needed to others which were in need. Much the same thing was done by diverting freight from routes which were congested to others which were less heavily loaded.

War Department shipments by rail in World War II approached 294 million tons, out of a total of 325 million tons by all forms of domestic freight movement from December 1941 through August 1945.[4] Stated another way, the railroads handled more than 90 percent of the total tonnage, or about nine times as much as by highway and inland waterway combined.

The movement of passengers was equally impressive. During the same 45 months, 33.7 million passengers in organized groups of 40 or more were moved. Of this total, 32.9 million or 97.6 percent were moved by rail, over 40 times the movement by highway carriers.[5]

It is interesting to consider why railroads could do so much work. The reason lies in the unique combination of the train, made up of a single power source pulling many vehicles, rolling on flanged wheels, over a steel roadway. This combination provides more productive use of power and human skill then is possible by any other means of transport.

The resulting efficiency is indicated by performance of the railroads in the peak year of the war, 1944. In that year, railroads hauled more than 1.5 billion tons of revenue freight an average distance of 473 miles, making 709.5 billion ton-miles of work performed. They also moved in the same year 910 million passengers an average distance of 105 miles, for a total of 95.5 billion passenger-miles. All this was accomplished with a total work force working on trains and engines, tracks, bridges, signals, roundhouses, stations and elsewhere of only 1.4 million employees.[6] Thus, on the average, every railroad employee in the peak war years, using the efficient plant and equipment provided by the railroads, was responsible for producing 522 thousand ton-miles of freight service and 67.5 passenger-miles of travel. This record of efficiency in use of manpower is unapproached by any other means of transport.

In summary the U.S. railroads made significant contributions to winning World War II by moving 30 percent of all freight covered by government bill of lading and 97 percent of all military group passenger travel with virtually no

increase in rolling stock. This accomplishment was the result of the unique ability of railroads to move large quantities of goods and people in an efficient and economic manner, and the splendid cooperation of shippers and the railroads. The next chapter will examine the trends in the U.S. railroad industry since World War II.

FOOTNOTES

CHAPTER II (Pages 5-8)

[1]U.S. Office of Defense Transportation, Civilian War Transport (Washington, D.C.: May 1948), p. 9.

[2]U.S. Office of Defense Transportation, Transport, p. iv.

[3]U.S. Office of Defense Transportation, Transport, p. 9.

[4]Association of American Railroads, Rail Transport and the Winning of Wars (Washington, D.C.: March 1956), p. 60.

[5]Association of American Railroads, Rail, p. 60.

[6]Association of American Railroads, Rail, p. 62.

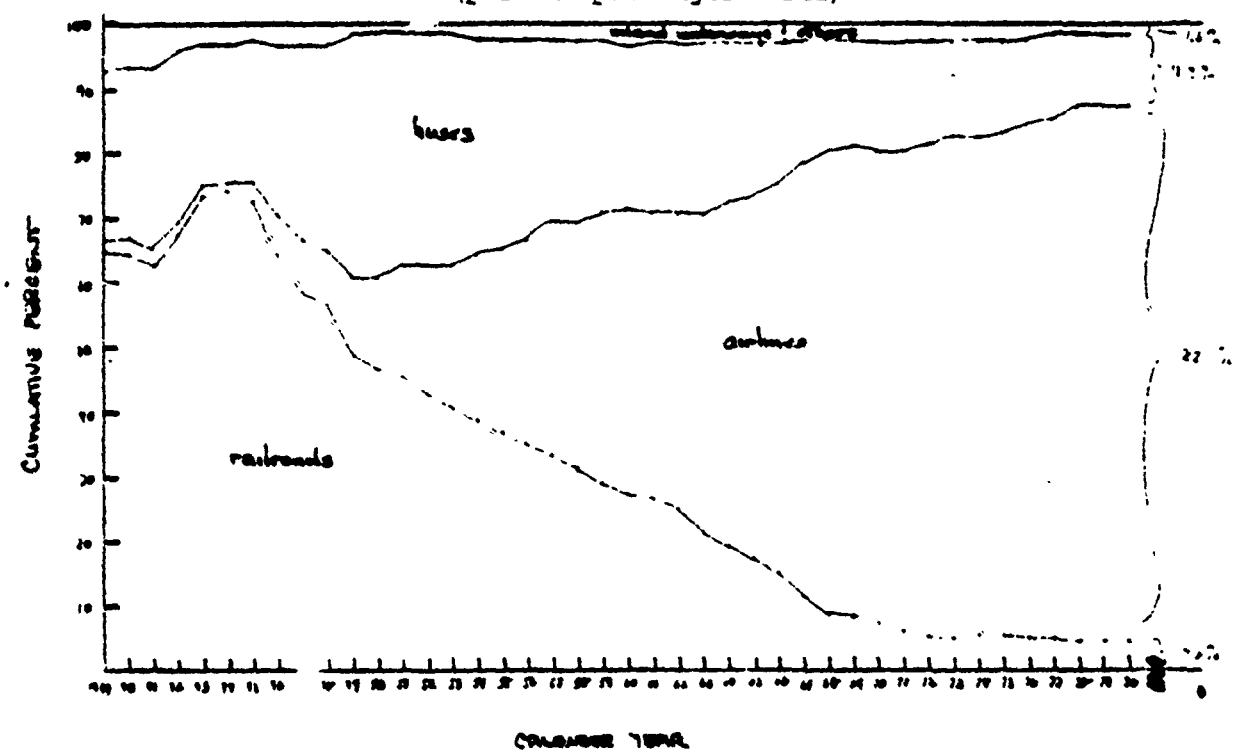
CHAPTER III

TRENDS IN RAILROAD CAPABILITIES

In 1944, when the rail industry was operating at its peak utilization, there existed 1,794,135 freight train cars[1] which traveled over 374,710 miles of track[2] and hauled approximately 69 percent of the United States intercity freight.[3] At the same time, the railroads had 46,558 passenger train cars in service[4] and carried about 74 percent of the commercial intercity passenger traffic.[5] Since then, there has been a significant shift in the United States reliance on various modes of transportation to move people and materials. The nature of this change will be examined in this section.

Since the shifts have been the most dramatic with respect to passenger service, that element will be examined first. As vividly portrayed in the following chart, the rail industry, which once dominated the passenger carrying business, is now overshadowed by the airline industry.

DISTRIBUTION OF COMMERCIAL INTERCITY
PASSENGER TRAFFIC IN THE UNITED STATES[6]
(percent passenger miles)



In 1944, the railroads, airlines, and buses shared 74.1%, 1.7%, and 20.9%, respectively, of a passenger business which accumulated a total of 128,990 million passenger miles.[7] By 1980, the most recent year for which data is available, the shares were 4.6% by the railroads, 82.5% by the airlines, and 11.3% by the buses. The total commercial passenger miles amassed during 1980 was 246,300 million,[8] meaning the railroads had about half the passenger miles they did in 1944, while the airlines had almost six times the passenger miles of the total for all modes of commercial transportation in 1944.

As a logical result of the shift in reliance from trains to planes for commercial travel, there has been a significant reduction in the number of passenger-train cars in service since 1944. As displayed in the following table, in 1980 there existed less than 10 percent of the passenger train cars in service in 1944.

PASSENGER TRAIN CARS[9]

Dec. 31	United States	Pullman Company	Eastern District	Southern District**	Western District
		Amtrak*			
1929 ...	61,728	9,469	27,001	6,961	18,297
1939 ...	45,479	7,052	21,042	4,589	12,796
1944 ...	46,558	8,751	21,314	4,517	12,006
1947 ...	44,941	6,071	21,680	4,557	12,433
1951 ...	42,406	5,276	20,197	4,372	11,561
1955 ...	36,871	4,776	17,748	3,816	10,531
1967 ...	16,610	1,021	9,324	2,501	5,764
1968 ...	15,384	765	8,116	2,129	4,374
1969 ...	12,426	—	6,683	1,878	3,865
1970 ...	11,177	—	6,254	1,524	3,399
1971 ...	8,713	1,165	5,321	700	1,527
1972 ...	7,589	1,571	4,107	630	1,281
1973 ...	7,189	1,777	3,729	546	1,137
1974 ...	6,846	1,848	3,467	502	1,031
1975 ...	6,471	1,913	3,128	416	1,014
1976 ...	5,478	2,062	1,975	492	949
1977 ...	5,512	2,154	1,947	501	910
1978 ...	4,493	2,064	1,226	300	883
1979 ...	4,241	2,028	1,252	210	753
1980 ...	4,347	2,128	1,259	187	773

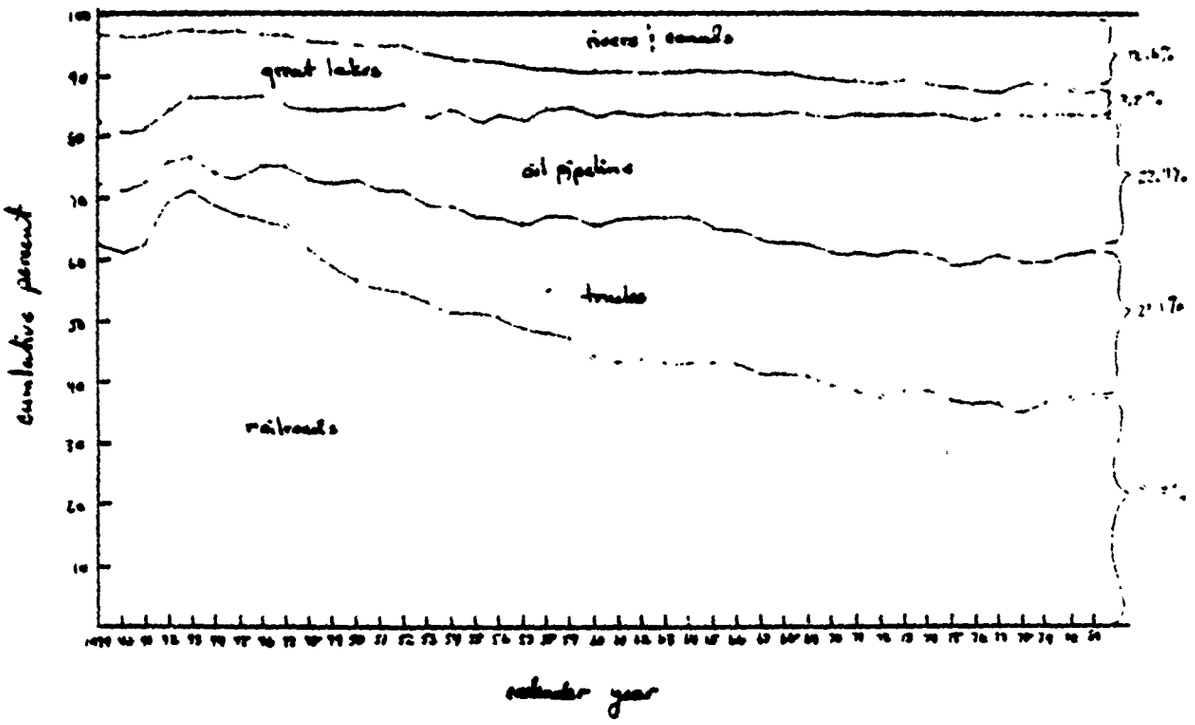
* Pullman Company cars from 1929 through 1968; Amtrak cars beginning in 1971.

** Includes Auto-Train for years 1972-1977.

Another significant, and related fact, is that today only the Budd Company still has the capability to manufacture passenger train cars. The others, including the legendary Pullman Company, have gone out of business.

The shift in the United States' reliance on the railroads to carry materials has been significant, but not as dramatic as that in passenger service. The following chart displays the trends from 1939 until 1981:

DOMESTIC INTERCITY FREIGHT BY MODES[10]
(percent of ton-miles)



The railroads' peak freight year was 1943, when their share of the intercity freight business was 71.3%, as compared to 5.5% for trucks, 9.5% for oil pipelines, and 13.7% for water transportation. By 1980, the railroads' share had shrunk to 37.9%, while the trucking industry had taken over 23.1% of the market.

As displayed above, oil pipelines accounted for 22.4% and water transportation the remaining 16.4%. Interestingly enough, in 1980, the airlines had only .17% of the intercity freight market.[11]

Predictably, as the railroad industry's share of the freight market declined from 1943, so did the number of freight cars in service. The following table shows the 14.7% decline from 1939 (pre-WW II) and the 19.1% decline from 1944 until 1981:

FREIGHT CARS[12]

Dec. 31	Total	Class I railroads	Other railroads	Car companies and shippers
1929	2,610,662	2,277,505	46,178	286,979
1939	1,961,705	1,650,031	30,486	281,186
1944	2,067,946	1,769,578	27,434	270,936
1947	2,025,008	1,734,239	25,519	265,250
1951	2,046,600	1,752,430	25,448	268,722
1955	1,996,443	1,698,814	24,933	272,696
1967	1,822,381	1,477,166	33,797	311,418
1968	1,800,375	1,453,853	30,688	315,804
1969	1,791,736	1,434,824	29,373	327,539
1970	1,784,181	1,423,921	29,787	330,473
1971	1,762,135	1,422,411	27,291	312,433
1972	1,716,937	1,410,568	22,749	283,620
1973	1,710,859	1,395,1[illegible]	23,114	292,440
1974	1,720,573	1,375,2[illegible]	25,977	319,331
1975	1,723,605	1,359,459	29,407	334,739
1976	1,699,027	1,331,705	34,452	332,870
1977	1,666,533	1,287,315	40,378	338,840
1978	1,652,774	1,226,500	68,881	357,393
1979	1,700,310	1,217,079	91,427	391,804
1980	1,710,827	1,168,114	102,161	440,552
1981	1,672,566	1,111,116	161,891	400,559

Along with the reduction in the total number of cars in service came a change in the composition of the freight car fleet. The accompanying table of "Freight Car Fleet Composition" depicts that change. As a matter of explanation, the ten generalized car types are a convenient way of grouping the thousands of different types, sizes, and component equipped cars being used.

COMPOSITION OF FREIGHT CAR FLEET IN SERVICE[13]

YEAR	BOX CARS PLAIN	BOX CARS EQPT	COVERED HOPPER	FLAT CARS	REFRIG CARS	GOND. CARS	HOPPER CARS	TANK CARS	STOCK CARS	OTHER
1967	436163	140877	147953	108581	118056	205665	430794	175640	16877	39539
1968	411565	148507	153532	113213	115978	205640	422558	177617	15324	38853
1969	394074	162154	161068	122705	115844	200141	405829	180797	12169	39601
1970	375668	171237	170742	128359	116026	19623[illegible]	399498	174749	39035	10477
1971	357850	176644	179919	128711	111647	192690	398199	169955	8863	37657
1972	340163	181131	186219	125554	107023	188713	383242	162350	6621	35921
1973	333607	178329	204926	132222	104721	187347	356333	165309	5307	33558
1974	328028	178169	219362	139186	104024	186220	356626	169237	4980	34241
1975	321480	173679	228265	141316	100815	186773	363186	170876	4423	32792
1976	302899	171054	230069	141781	98017	185776	365526	168018	3637	32250
1977	280367	170412	235829	142811	93823	179475	359168	169745	2943	31960
1978	262986	172685	246087	146402	87601	175777	354086	174170		32980
1979	274002	179217	268919	151377	81266	178979	356504	178069		31977
1980	251420	179944	299986	152661	79370	184875	347867	183989		30715
1981	222747	172428	311378	148724	73452	183692	339435	190662		30047

Note: These figures reflect the numbers of cars owned by Class I railroads, other railroads, and car companies and shippers. Data available prior to 1967 was available for only Class I railroads, and the car groupings were different. As a result, those figures were not included in this table.

Plain box cars are probably the best known, and are the most versatile of those in the fleet. Equipped box cars are those with special features and modifications that allow them to handle special commodities. Covered hopper cars are designed for bulk commodities which require protection from the elements. Flat cars serve many purposes, but today are primarily used to haul trailers or, with special racks, to haul automobiles. Refrigerator cars, as the name implies, are simply box cars to which refrigeration equipment has been added to permit them to carry perishable consumables. Gondola cars are designed to carry commodities which are both very heavy and need no protection from the elements. Hopper cars are used primarily to carry coal. The tank cars carry a variety of commodities in liquid or gas form, such as chemicals, liquid food products, and fertilizers, to name a few.

With respect to the change in the composition of the freight car fleet, two points are significant and are worth noting. The first concerns the decline in the number of plain box cars. As dramatic a decline as the table depicts from 1967, that almost pales in comparison with the decline since the peak of WW II. In 1944 there were 745,465 box cars,[14] and, because of the accounting practices in effect at that time, that number represents only those owned by Class I railroads. The other important trend involves the increase in the number of flat cars. Much of this increase can be attributed to the greater use of Trailer-on-Flat-Car/Container-on-Flat-Car (TOFC/COFC), otherwise known as Piggyback Loadings, as modes of shipping. While TOFC/COFC has not been as popular as originally anticipated, the growth depicted in the following table represents an important change in the mode of shipping various materials.

PIGGYBACK LOADINGS[15]

Year	Revenue Cars				Trailers and Containers
	United States	Eastern District	Southern District	Western District	
1957 ..	249,065	130 211	6,755	112,699	—
1958	278 271	139 070	8 303	130 098	—
1959 . .	476,508	204 010	10 687	201 811	—
1960 .	554 115	263,817	21,128	269 170	—
1961	691,246	299 605	37 749	253,892	302,260
1962 ...	706,441	369,840	64,783	271,818	1,139,220
1963	815,773	394 398	105,511	315 364	1 294,090
1964 ...	920,827	446,311	129,417	345,099	1 455 523
1965 ...	1 076,820	508,189	173,762	394 869	1 564,929
1966	1,224,337	564,348	207,163	452,826	1,912,419
1967	1,277,410	568,089	225,053	484 268	1,983,793
1968	1,509,843	659,471	276,373	573,999	2,419,217
1969	1,539,797	632,433	303,236	604,128	2,497,586
1970	1,449,519	565,518	311,225	572,776	2,363,200
1971	1,356,394	511,377	319,422	525,095	2,203,530
1972	1,448,075	599,177	354,184	494,714	2,407,034
1973	1,630,795	610,874	403,929	615,392	2,758,044
1974	1,509,876	594,208	405,404	610,264	2,752,825
1975	1,307,520	463,779	337,005	506,736	2,238,117
1976	1,505,945	456,670	422,272	627,003	2,538,318
1977	1,888,806	471,965	483,050	733,791	2,850,231
1978	1,840,588	469,436	524,014	847,138	3,177,291
1979	1 857,705	479,662	508,903	869,140	3,278,163
1980	1,561,110	430,393	445,460	785,257	3,014 364
1981	1,723,410	425,448	469,587	828,355	3,102,764

But, as total freight fleet size decreased and the composition changed, the railroads attempted to increase productivity and remain competitive by increasing car capacities. The following table shows consistent growth since 1929:

AVERAGE FREIGHT CAR CAPACITY[16]

	Tons		Tons
1929	46.3	1971	68.4
1939	49.7	1972	69.6
1944	50.8	1973	70.5
1947	51 5	1974	71.6
1951	52.9	1975	72.9
1955	53.7	1976	73.8
1966	61.4	1977	75.5
1967	63.4	1978	76 9
1968	64.3	1979	77 7
1969	65 8	1980	79 4
1970	67.1	1981p	80.4

Average car capacities will continue to rise as large cars (the average for new cars introduced in 1981 was 95 tons[17]) are brought into service and the older, smaller ones are retired.

The net result of employing cars with larger capacities was a freight car fleet aggregate capacity of over 135 million tons in 1980. This is a 39.3% increase over the 97 million ton capacity in 1939, and a 29.3% increase of the aggregate capacity available during the near peak World War II year of 1944.

Freight car numbers, types, and sizes are meaningless without locomotive power to pull them. As with freight cars themselves, the numbers and types of locomotives have changed over the years since World War II. As displayed in the following table, the steam engine fleet of fifty years ago has been replaced with about half as many diesel electric units in 1981.

LOCOMOTIVES IN SERVICE[18]

Dec. 31	Total	Diesel electric units	Steam	Electric units	Other
1929	57,571	22	56,936	601	12
1939	42,511	510	41,117	843	41
1944	43,812	3,049	39,681	863	19
1947	41,719	5,772	35,106	821	18
1951	40,036	17,493	21,747	780	16
1955	31,429	24,786	5,982	627	34
1967	27,687	27,309	21	321	36
1968	27,376	27,017	21	305	33
1969	27,033	26,714	21	276	22
1970	27,096	26,796	13	288	9
1971	27,189	26,897	13	250	29
1972	27,356	27,064	13	252	29
1973	27,790	27,540	12	238	—
1974	28,084	27,857	12	215	—
1975	28,210	27,985	12	213	—
1976	27,612	27,383	12	217	—
1977	27,667	27,450	12	205	—
1978	27,400	27,184	12	204	—
1979	28,097	27,922	12	163	—
1980	28,396	28,243	12	141	—
1981	28,087	27,981	12	74	—

Despite its fewer numbers, the modern locomotive fleet represents an increase in total capability over the earlier fleet of smoke-billowing iron horses. Today's diesel electric locomotive is more powerful, as evidenced by the 1981 aggregate horsepower of the fleet being 65 million as compared with 54.2 million horsepower in 1971.[19] The diesel electric locomotive has "greater immediate tractive power . . . enabling [it] to pull longer, heavier trains."[20] These engines are also faster and more reliable than their predecessors.

The net effect of fewer, but higher capacity cars, being pulled by more powerful locomotives, in trains of greater length, is the railway's ability to move greater quantities of materials. This fact is evidenced by the following sets of information. The first set shows average freight train loads doubling since 1944, and the second shows that, even with the depressed state of today's railroads, they are handling more revenue producing cargo than in 1944.

AVERAGE FREIGHT TRAIN LOAD[21]
(net ton-miles per freight train-mile)

	United States –	Eastern District	Southern District	Western District
1929	804	981	622	702
1939	806	1,043	513	679
1944	1,124	1,326	879	1,050
1947	1,131	1,353	910	1,033
1951	1,283	1,466	1,108	1,201
1955	1,359	1,488	1,342	1,264
1967	1,740	1,939	1,905	1,566
1968	1,768	1,972	1,874	1,614
1969	1,804	1,994	1,951	1,649
1970	1,820	1,981	1,881	1,703
1971	1,751	1,797	1,829	1,697
1972	1,774	1,823	1,867	1,716
1973	1,844	1,892	1,955	1,784
1974	1,875	1,992	1,954	1,790
1975	1,938	2,011	1,994	1,883
1976	1,954	2,013	1,963	1,922
1977	2,029	2,097	2,033	1,998
1978	2,029	2,068	2,009	2,020
1979	2,096	2,169	1,940	2,121
1980	2,175	2,223	2,012	2,213
1981	2,263	2,306	2,186	2,309

REVENUE TON-MILES[22]
(ton-miles in millions)

	United States	Eastern District	Southern District	Western District
[illegible]	447,322	231,420	55,163	160,738
[illegible]	333,436	169,024	42,547	121,868
[illegible]	737,246	330,014	98,082	309,150
[illegible]	654,728	294,967	88,243	271,518
[illegible]	646,620	275,239	90,725	280,657
[illegible]	623,615	256,701	90,444	276,469
[illegible]	719,486	258,361	127,988	333,149
[illegible]	744,023	259,391	130,686	353,946
[illegible]	767,841	259,827	139,256	368,757
[illegible]	764,809	254,467	140,034	370,309
[illegible]	738,743	225,619	139,660	374,464
[illegible]	778,746	231,221	147,116	398,410
[illegible]	851,809	246,022	157,879	448,907
[illegible]	850,961	248,396	160,686	441,885
[illegible]	754,252	217,909	140,261	396,083
[illegible]	794,059	216,644	151,020	426,395
[illegible]	826,292	211,278	160,689	454,326
[illegible]	858,105	197,833	162,417	498,056
[illegible]	913,689	214,116	165,188	534,385
[illegible]	918,621	202,036	168,585	548,001
[illegible]	991,766	188,169	167,334	548,671

Another indicator of the capability of the nation's railroads to move materials is the extent and condition of the track and roadbeds crisscrossing the country. The data in the following table represents the total miles of railroad track, including multiple main tracks, yard tracks, and sidings, owned by both line-haul and switching and terminal companies:

MILES OF TRACK OWNED[23]

1939	386,085	1970	336,332
1944	374,710	1971	334,932
1947	374,027	1972	331,129
1949	372,801	1973	328,625
1951	371,782	1974	327,285
1955	366,405	1975	324,156
1965	345,422	1976	312,770
1966	344,001	1977	310,800
1967	341,499	1978	309,700
1968	339,781	1979	300,000
1969	338,795	1980	[illegible]

Faced with this 22.6 percent decline in the amount of railroad track owned, recognizing the importance of the railway system to support the nation's defense establishment, and having concern over the condition of the available railways, the Military Traffic Management Command (MTMC) conducted a study of the rail lines important to the national defense. That study, completed in June 1981, examined the condition of the rail lines composing the Strategic Rail Corridor Network (STRACNET) and connectors between STRACNET and defense facilities which depend on rail service. The study concluded:

> "The condition of STRACNET lines and connector lines is satisfactory for national defense. Only 233 miles of the 32,500-mile STRACNET do not meet readiness conditions established by this report . . . . The mileage is well dispersed and represents only 0.7 percent of the 32,500-mile STRACNET. Because of the redundancy in the nation's rail systems, alternate routings are often available. Finally, since 95 percent of STRACNET permits speeds equal to or in excess of 40 miles per hour, the 233 miles do not appreciably affect overall average trip speeds. Therefore, the 233 miles are not a problem to national defense."[24]

The last, but certainly not least, surrogate indicator of the railroads' capability to transport materials is its rate of return on investment, or indice of economic health. As the following table shows, the rate of return has been extremely low since 1967, with a slight reversal in the past few years. Of the many reasons for the low rate of return, possibly the most important is the railroads' lack of competitiveness with the trucking industry. For many years, the railroads were unable to compete because of excessive government regulation. Many of the restrictions imposed on the railroads have been eased as the result of the passage of the 1973 Regional Rail Reorganization Act, the 1974 Railroad Revitalization and Regulatory Reform Act, and the 1980 Staggers Rail Act.

RATE OF RETURN ON NET INVESTMENT[25]

	United States	Eastern District	Southern District	Western District
1929	5.30%	5.33%	4.27%	4.35%
1939	2.56	3.14	2.77	1.85
1944	4.70	4.37	5.45	4.32
1947	3.44	3.02	3.52	3.34
1951	3.78	3.47	4.74	3.78
1955	4.22	4.19	5.45	3.98
1967	2.46	1.58	3.86	2.75
1968	2.44	1.27	3.79	3.01
1969	2.36	1.10	4.17	2.91
1970	1.73	def.	4.50	3.02
1971*	2.12	def.	4.36	3.51
1972*	2.34	0.11	4.61	3.34
1973*	2.33	0.07	4.61	3.30
1974*	2.70	0.46	4.73	3.66
1975*	1.20	def.	3.98	2.65
1976*	1.60	def.	4.63	3.57
1977*	1.24	def.	5.23	3.71
1978*	1.52	def.	5.17	4.22
1979*	2.97	def.	5.38	4.38
1980*	4.13	0.08	6.02	5.46
1981*	3.98	2.65	5.24	4.18

*Reflects inclusion of deferred taxes.

In summary, there have been significant changes in the role of the railroads of the United States since World War II. They have lost their importance for commercial passenger transportation to the airlines. They have lost a large part of their role in moving materials to the trucks and oil pipelines. They have reduced the number of cars in their fleet, and have changed the composition of that fleet. Economic conditions have forced the abandonment of many miles of trackage, but the existing track essential to national defense seems to be adequately maintained. Despite these negative trends, the railroads have been able to maintain their aggregate hauling capacity. The significance of all this will be discussed in the next chapter.

FOOTNOTES

CHAPTER III (Pages 10-21)

[1]Data provided by the Association of American Railroads, January 1983.

[2]Association of American Railroads, Economics and Finance Department, Yearbook of Railroad Facts, 1982 (Washington, D.C.: September 1982), p. 43.

[3]Transportation Association of America, Transportation Facts and Trends, 17th ed. (Washington, D.C.: December 1981): p. 3.

[4]Association of American Railroads, Yearbook, p. 51.

[5]Data provided by the Association of American Railroads, January 1983.

[6]Data provided by the Association of American Railroads, January 1983.

[7]Data provided by the Association of American Railroads, January 1983.

[8]Data provided by the Association of American Railroads, January 1983.

[9]Association of American Railroads, Yearbook, p. 51.

[10]Transportation Association of America, Facts, p. 3.

[11]Transportation Association of America, Facts, p. 3.

[12]Association of American Railroads, Yearbook, p. 47.

[13]Data provided the Association of American Railroads, January 1983.

[14]Data provided by the Association of American Railroads, January 1983.

[15]Association of American Railroads, Yearbook, p. 27.

[16]Association of American Railroads, Yearbook, p. 49.

[17]Association of American Railroads, Yearbook, p. 49.

[18]Association of American Railroads, Yearbook, p. 45.

[19]Association of American Railroads, Yearbook, p. 45.

[20]Reebie Associates, 'The Railroad Situation' - A Perspective on the Present, Past and Future of the U.S. Railroad Industry, PB-298 842 (Greenwich, Conn.: September 1978), p. 349.

[21]Association of American Railroads, Yearbook, p. 38.

[22]Association of American Railroads, Yearbook, p. 30.

[23]Association of American Railroads, Yearbook, p. 43.

[24]Letter from Paul H. Riley, Deputy Assistant Secretary of Defense (Supply, Maintenance and Transportation) to Senator John G. Tower, Chairman Senate Armed Services Committee, 26 June 1981.

[25]Associaton of American Railroads, Yearbook, p. 19.

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

During World War II, the United States railroad industry was the principal domestic mover of material and manpower. Since the end of World War II, there has been a significant shift in the manner in which railroads support the national economy. The implications of these shifts on the use of railroads in event of mobilization to meet a national emergency are:

o Although there has been a reduction of 22.6 percent in railroad track owned since 1944, the remaining Mainline Strategic Rail Network is sufficient to meet the nation's mobilization needs. Additionally, the interfaces between this rail network and defense facilities are being monitored by MTMC. However, no study has been conducted to assure that adequate rail connections exist with defense industry suppliers, their sources of supply, nor within the confines of defense installations.

o The loss of over 90 percent of the passenger carrying capacity since 1944 to other forms of intercity movement, primarily airlines, virtually eliminates railroads from being a viable mover of personnel in a future conflict. Thus, airlines will be the prime mover of people in any future war, as they are in peacetime.

o The movement of high volume cargo, as was the case in World War II, is the strong suit of railroads. However, since World War II, the nation's railroads have reduced their capacity to move non-containerized cargo in box cars by 70 percent. Since 1961, the railroads have increased their ability to move cargo on flat cars in containers or trailers over threefold. This shift in

emphasis, when coupled with a similar shift in sealift capability, indicates that a greater reliance on containerized transport will yield the greatest economic and efficient form of transport in the event of mobilization.

o The deregulation of inland transportation by the Staggers Rail and Motor Carriers Acts of 1980 should revitalize the rail and motor transport carriers. This revitalization will lead to more containerized cargo which can be jointly handled by both trains and trucks. However, in the event of conflict, there will need to be a capacity to fabricate containers in the United States to meet increased demand and replace those shipped overseas.

These implications lead to the recommendations that:

o DOD conduct a study to assess the state of rail service between defense supplies and the Strategic Rail Network, and of rail facilities within defense installations.

o DOD work closely with the rail industry to refine the defense transport needs to the capabilities of the nation's railroads.

o DOD move more into containerized transport by prestaging Warfare Reserve material in containers for rapid movement.

o DOD assess the surge capability of fabricating containers and stockpiling them if needed.

BIBLIOGRAPHY

Association of American Railroads. Assorted data provided upon request: January 1983.

Association of American Railroads. American Railroads and the War. Washington, D.C.: 1943.

Association of American Railroads. Yearbook of Railroad Facts, 1982 Edition. Washington, D.C.: 1982.

Blackburn, Douglas. Director, Mobilization Concepts Development Center, National Defense University. Interview: October 20, 1982.

General Accounting Office. Transportation Issues in the 1980s. Washington, D.C.: September 1980.

Hultgren, Thor. Railway Traffic Expansion and Use of Resources in World War II. National Bureau of Economic Research, Inc. Washington, D.C.: 1944.

Interstate Commerce Commission, Association of American Railroads, and Department of Defense, Office of Civil Defense. Railroad Planning for National Defense Emergencies. Washington, D.C. 1970.

McCleave, Colonel Robert E. (USA). Associate Director, Mobilization Concepts Development Center, National Defense University. Interview: January 24, 1983.

Masters, Lieutenant Colonel Larry (USA). Office of Plans and Strategic Mobility, Military Traffic Management Command. Interview: December 1982.

Military Traffic Management Command. A Study of Rail Lines Important to National Defense for the Armed Forces Committees of the Congress. Washington, D.C.: June 1981.

Military Traffic Management Command. Department of Defense Installations and Activities Requiring Rail Service. Washington, D.C.: March 1981.

Military Traffic Management Command. MTMC Report RND 76-1 An Analysis of a Strategic Rail Corridor Network (STRACNET) for National Defense. Washington, D.C.: November 1976.

Military Traffic Management Command. Worldwide Traffic Management Summary, Fiscal Year 1981. Washington, D.C., not dated.

Reebie Associates. The Railroad Situation--A Perspective on the Present, Past and Future of the U.S. Railroad Industry. Greenwich, Conn.: September 1978.

Swift, J. S. Representative of Association of American Railroads, Military Traffic Management Command. Interview: October 1982.

Transportation Association of America. Transportation Facts and Trends. Washington, D.C.: December 1981.

U.S. Congress, Senate Committee on Commerce, Staff Analysis. The American Railroads: Posture, Problems, and Prospects. Washington, D.C.: 1972.

U.S. Office of Defense Transportation. Civilian War Transport. Washington, D.C.: 1946.

Van Fleet, General James A. (USA, Ret). Rail Transport and the Winning of Wars. Washington, D.C.: 1956.

White, Elston T. Transportation. Washington, D.C.: 1981.

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